ISBN : 978-602

Padang, Novemb

4th Intern
on Techn
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Theme :

Technical ar
Training for

PROCEEDINGS 4th International Conference on TVET P

UNP PRESS

163	Riki Adriadi, Ganefri and Fahmi Rizal	EMPLOYEE PRODUCTIVITY IN TWO CROSS CULTURES BASED ENTREPRENEURSHIP
164	Sri Wahyuni, Kana Saputra Saragih, Mochammad Iswan Perangin-Angin	THE IMPLEMENTATION OF DECISION TREE ALGORITHM C4.5 USING RAPIDMINER IN ANALYZING DROPOUT STUDENTS
165	Tyas Asih Surya Mentari, Murni Astuti, and Linda Rosalina	DEVELOPMENTAL OF MEDIA LEARNING BASED ON TUTORIAL VIDEO AT CHARACTER MAKE UP SUBJECT IN SMKN 6
166	Wenny Marthiana, Suryadimal, Edi Septe, Duskiardi, Andika	THE APPLICATION OF SIMPLE STRAIN GAUGE DYNAMOMETER IN LEARNING STYLE CUTTING LATHE
167	Yuliarma	MODEL OF DESIGN DESIGN OF ACULTURATIVE SULAMAN MINANGKABAU IN LEARNING DESIGN VARIOUS DESIGN
168	Wakhinuddin S, Donny Fernandez, Andrizal, M Nasir, Rifdarmon	USE OF GEARBOX VIAR ON FISHING SHIPS
169	Mulya Gusman, Totoh Andayono, Dedi Yulhendra, Adree Octova	THE EFFECT OF TOTAL RESISTANCE AND SPEED TO *FUEL CONSUMPTION OF DUMP TRUCK HD* 465-7 IN COAL MINING
170	Yasdinul Huda, B Herawan Hayadi	SMART CLASSROM DESIGNS IN THE SMART EDUCATIONAL ENVIRONMENT
171	Jusmita Weriza	PATIENT INFORMATION SYSTEM DESIGN ON MATERNITY HOSPITAL RESTU IBU PADANG
172	Rasinov Chandra, Mawardi, Anggi Aprianto, Reza Rahmadani	AUTOMOTIVE DEPARTMENT STUDENT PERCEPTION ON LECTURER COMPETENCIES, LEARNING FACILITIES, AND LEARNING MEDIA TO LEARNING ACTIVITIES
173	Edidas dan Legiman Slamet	CREATE A MICROCONTROLLER TRAINER KIT ON MICROCONTROLLER SYSTEM COURSE
174	Edidas, Legiman Slamet dan Ilmiyati Rahmy Jasril	MICROCONTROLLER SKILL TRAINING FOR SMKN 2 PAYAKUMBUH AND SMKN 1 SUNGAI RUMBAI
175	Liliana, Afriani, Anwardi	OPTIMIZATION OF EXTERNAL LIGHTNING PROTECTION SYSTEM DESIGN IN BUILDING CENTER FOR INFORMATION TECHNOLOGY AND DATA BASE (PTIPD) UIN SUSKA RIAU
176	Safrian Aswati, Saleh Malawat, Suhendra, Iskandar, Yessica Siagian, Arridha Zikra Syah	PERSONNAL MANAGEMENT IN INFORMATION SYSTEMS APPLICATIONS WITH TOGAF FRAMEWORK

DAFTAR ISI PROSIDING 4th ICTVET UNP 2017

FOREWORDS

This proceeding aims to disseminate valuable ideas and issues based on research or literature review in the field of vocational, technical and engineering studies, which have been presented in 4th International Conference on Technical and Vocation Education and Training. This conference has taken place in Hospitality Center Universitas Negeri Padang, November 9-11, 2017.

The theme of Conference focused on the perspective of technical and vocational education and training for sustainable society to face the challenges of 21st century, globalization era, and particularly Asian Economic Community. To overcome the challenges, we need the innovation and change in human resources development. Technical vocational educational and training have essential roles to change the world of education and work in order to establish sustainable society.

Undoubtedly, TVET need to enhance the quality of learning by developing various model of active learning, including learning in the workplace and entrepreneurship. Create innovation and applied engineering as well as information technology. Improvement of management and leadership in TVET Institution, and development of vocational and technical teacher education.

Many ideas and research findings have been shared and discussed in the seminar, more than 176 papers have been collected and selected through scholars, scientists, technologist, and engineers'. as well as teachers, professors, and post graduates students who participated in the conference.

Eight keynote speakers have taken a part in the conference, namely Prof. Intan Ahmad, Ph.D. (Director general of learning and student affairs, Kemenristek Dikti) and Prof. Josaphat Tetuko Sri Sumantyo, Ph.D. (CEReS Chiba University) and Prof. Dr. Maizam Alias (UTHM Malaysia) and Prof. Ganefri, Ph.D. (Rector of UNP) and Prof. Dr. Ramlee bin Mustapha (UPSI Malaysia) and Prof. Nizwardi Jalinus, Ed.D. (Chair of TVET doctoral program, FT UNP) and Prof. Michael Koh, Ph.D. Dr. Fahmi Rizal, M.Pd., MT (Dean of FT UNP). They all have a great contribution for the success of the conference.

Finally, thank a million for all participants of the conference who supported the success of 4th International conference on TVET 2017 and most importantly, our gratitude to all scholars who support and tolerated our mistake during the conference.

Padang, 9 November 2017

Prof. Dr. Nizwardi Jalinus, M.Ed
Chair of Scientific Committee

4th International Conference on Technical and Vocation Education and Training
Padang : November 9-11, 2017

OPTIMIZATION OF EXTERNAL LIGHTNING PROTECTION SYSTEM DESIGN IN BUILDING CENTER FOR INFORMATION TECHNOLOGY AND DATA BASE (PTIPD) UIN SUSKA RIAU

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[1]Pascasarjana UNP, [2,3] UIN Suska Riau

ABSTRACT: External protection system at tall building is critical to protect it from lightning strikes. Building of Pusat Teknologi Informasi dan Pangkalan Data (PTIPD) is one of the tall buildings in UIN Suska Riau, which should have a good security from interference by lightning. This study aims to analyze the needs of Lightning Protection System (SPP) of the building, evaluate the condition of the current building protection system now, and trying to optimize the system of protection that have to do the analysis and design of external protection system of the building. In this study, external protection system design of buildings using conventional methods, there are Mesh Size, Rolling Sphere, and protective angle . The results of analysis needs of lightning protection systems for buildings PTIPD UIN Suska Riau based on the level of protection at the level of IV with forecasts of great danger, the protection system of the building is currently showing at least the area protected, the result of design shows the method of Rolling Sphere which provides overall protection area of the building with optimal.

Key Word : External Protection System, Building of PTIPD, SPP, Conventional Methods

Background

Lightning protection systems in the building protection system includes external and internal, external protection system serves to reduce the risk to the danger of damage due to lightning strike directly. Direct lightning strike can cause damage to buildings, equipment, fire and casualties. While the internal lightning protection system serves to protect the installation of equipment in buildings against overvoltage due to lightning strike, such as affecting the performance of the equipment contained within the building as well as shorten the life of the use of the equipment. This can cause huge losses so that it takes effort to reduce it to use a lightning protection system. Lightning strikes can cause disturbances in the power system. In the building / buildings,

State Islamic University Syarif Kasim Sultan Riau is one of the State University in the city of Pekanbaru, located on the equator at 101 degrees 18'-coordinates of 101 degrees 36 'east longitude and 0 degrees 25'-0 degrees 45' north latitude, lightning the higher the closer the location of lightning to the equator. The lightning strike in order to not harm humans and equipment on the building, the building protection system should be planned so as to protect the building from lightning strikes. The lightning strike may contain the value of current or voltage impulse is very high if it is not secured can harm the system struck.

One of the existing building at UIN Suska Riau is Building Center for Information Technology and Data Base (PTIPD). This building is one-storey building which was founded in 2006, the building was intended to be a place the operational activities of the information technology and databases to improve the quality of education and teaching, research and community service. As a center for information technology and databases, this building there are many electronic devices such as computers, television, air conditioner and other electrical equipment as well as many human activities are carried out. Hence the need for a lightning protection system for securing the building and that it contains from sembaran danger of lightning.

The results of the interview persons namely one technician UIN Suska Riau Mr. Nurman Indra unknown although this building has had a system of external protection, but from the information obtained from his house PTIPD still experience a disruption in the database and servers that exist inside the building after a moment the lightning strikes that happened. This disorder causes loss of activity in the building Puskom UIN Suska Riau and all academics who use the services of this building.

With the abundance of equipment and human lives in the building as a central database PTIPD UIN Suska Riau it is necessary to design an external lightning protection system that is useful to minimize the impact caused by a lightning strike to

4th International Conference on Technical and Vocation Education and Training
Padang : November 9-11, 2017

the building. The problem here is the reference the authors to raise the research entitled "Optimization of External Lightning Protection System Design In *Building Center for Information Technology and* Data Base UIN Suska Riau".

Basic Teory

Lightning strikes Effects

Natural state tropical climate of Indonesia in general, including areas with high lightning days per year. Due to data limitations magnitude of the lightning to any location in Indonesia, at this point it is assumed that the locations are high on a mountain or a tower that stands out amid the free area such as the fields have the possibility of strokes higher than the places in the middle being surrounded town surrounded by other high-rise building (Tabarani, 2009).

The annual frequency of direct lightning strike (Nd) may be formulated

$$Nd = 4.\ 10\text{-}2.\ T1.26.\mathrm{ab} + 6\mathrm{h}\ (\mathrm{a} + \mathrm{b}) + 9\pi\mathrm{b}2.\ 10\text{-}6 \qquad (1)$$

Where:
a = length of the roof of the building (m)
b = width of the roof of the building (m)
h = height of buildings (m)
T = days of thunder per year

Building Supplies Lightning Rod Installation Will Existence

The magnitude of the needs of a building will be the installation of a lightning rod, is determined by the magnitude of potential damages and the dangers posed when the building was struck by lightning. The magnitude of the needs can be calculated empirically based indices stating certain factors such as shown in the table below. The sum of these indices will obtain the approximate value of the dangers (R) as a result of lightning strikes by General Rules standard Lightning Distributors Installation (PUIPP).

$$R = A + B + C + D + E \qquad (2)$$

Where
A = Hazards Based on Usage and Content
B = Various Building Construction
C = Various High Building Construction
D = Various Building Situation
E = Wide Day of Guntur per Year
Where the greater the R value, the greater the danger and damage that caused the lightning strike.

Table 1. Index F - Estimated hazard

R	Danger Forecast	security
under 11	*be ignored*	*No need*
With 11	Small	No need
12	moderate	recommended
13	biggish	recommended
14	Big	Highly recommended
More than 14	Very large	It is necessary

Source: General Rules of Installation Distributors Lightning (PUIPP) for buildings in Indonesia

Estimated Ratio Based on the International Electrotechnical Commission (IEC) 1024-1-1. Based on the standard IEC 1024-1-1, the selection of adequate levels of protection for a lightning protection system is based on the frequency of direct lightning strike (Nd) which is expected to a protected structure and frequency of lightning strikes annually (Nc) are allowed. Decision-making on whether or not to install lightning protection systems in buildings is based on the calculation of Nd and Nc performed as follows (ISO 2006):

1. If Nd ≤ Nc do not need lightning protection systems
2. If Nd> Nc required lightning protection system with efficiency:

$$E \geq 1 - \frac{N_c}{N_d} \qquad (3)$$

Table 2. Lightning Protection System Efficiency

level of Protection	*efficiency SPP*
I	0.98
II	0.95
III	0.90
IV	0.80

External Protection System

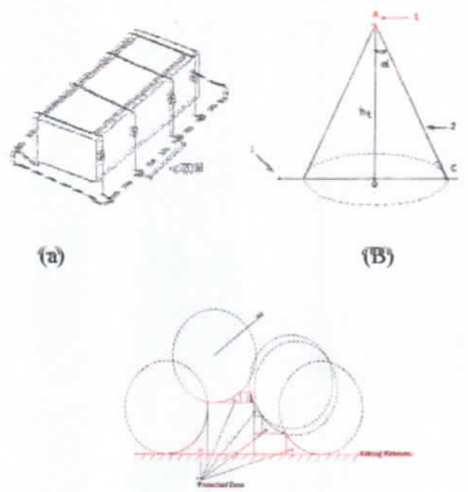
External protection is the installation and equipment outside of a structure to capture and deliver the lightning current into the grounding system. External good protection consists of air terminations, the conductor supplier and grounding system.

Table 3. Placement of Termination In accordance with the Air Protection Level

Level Protection	rolling Sphere r (m)	Corner protected α0				width Jala (M)
		20 M	30 M	45 M	60 M	
I	*20*	*25*	-	-	-	*5*
II	30	35	25	-	-	10
III	45	45	35	25	-	15
IV	60	55	45	35	25	20

Source: SNI-03-7015-2004

The method used to determine the placement of air terminations and to know the area of protection in this study is the method of Jala, Rolling Ball Method and Angle Method of Protection. Jala method used for the protection of a flat surface because it can protect the entire surface of the building, both Rolling Ball method used in the building that looks complicated. With this method as if there is a sphere with radius R rolling on the ground, around the structure and on top of the structure in all directions to meet with the land or structures related to the earth's surface that is able to work as a conductor. Point touch the ball rolling on the structure is a point that can be struck by lightning, and at that point must be protected by air termination conductor.



(a) (B)

(C)

Figure 1. Method (a) Method of Jala, (b) Protected angle, (c) Ball Rolling

Research methods

Data collection

Table 4. Data PTIPD Building UIN Suska Riau

Long Building (a) Meter	22
Building width (b) Meter	26
Number of People (N) People	160
Present Time (F) Hours / Year / People	2080
Grounding Resistivity (R) Ohm	10
Distance Grounding Of Building (D) Meter	3
Surface Outdoors	Concrete
Building And Characteristics Material Type	ordinary; Concrete

Table 5. Data Protection Building Material Specification

Protection components	type of Material	Form	Size	amount
Lightning Rod Upright	Galvanized steel	Cylinder pipe	10 mm	1
Conductor Top Distributors	Copper	gyre	50 mm2	1

Table 6. Data Meteorology, Climatology, and Geophysics Pekanbaru

Magnitude / Parameters	Value
Data IKL (Days of Thunder Average Per Year) (Day) (Fg)	136
Geographic Location (Latitude) (Degrees) (Li)	00:28 LS
Geographic Location (Longitude) (Degrees)	BT 101.27
Rainfall Average Per Year (mm / yr)	3073.8
High Low Clouds (m) (Ha)	304.8
High Above Sea Level (m)	31

(Source: BMKG, 2014)

In this study, there are several stages to the results obtained in the form of an external lightning protection system design which will be explained as follows.

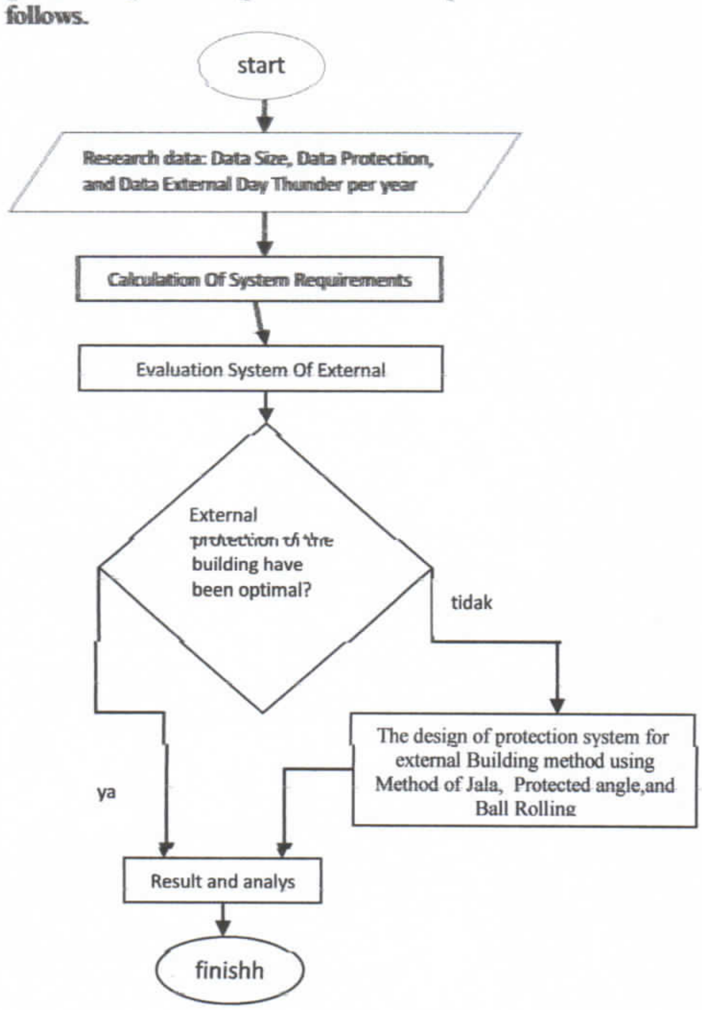


Figure 2 Stages Research

Results and Analysis

Results Calculation of Lightning Protection System (SPP)

Table 7. Results of Calculation of Lightning Protection System (SPP)

Calculation	value Calculation building PTIPD
The density of ground lightning strikes annual average (Ng)	19.5128
Area coverage equivalent (Ae) km2	19977.78
The frequency of direct lightning strike (Nd)	.389
Efficiency	0.74
Rated R	14
Estimated hazard	Big
Level Level of Protection	IV
Protected corner	550
The width of the net	20 meters
The radius of Rolling Sphere	60 meters
External SPP needs	*Yes*

From Table 7 it can be analyzed that would need lightning protection systems for buildings Puskom UIN Suska Riau based on the level of protection at the level of IV with forecasts of a very great danger, will do the evaluation of external protection current building methods Corner Protected with an angle of 550, if the result then the next evaluation is not to design optimal placement of air terminations using Protected by a large angle angle 550, Rolling ball method with a radius of 60 m, and a method of inter-mesh nets with a width of not more than 20 m.

Building Protection Systems External Evaluation PTIPD

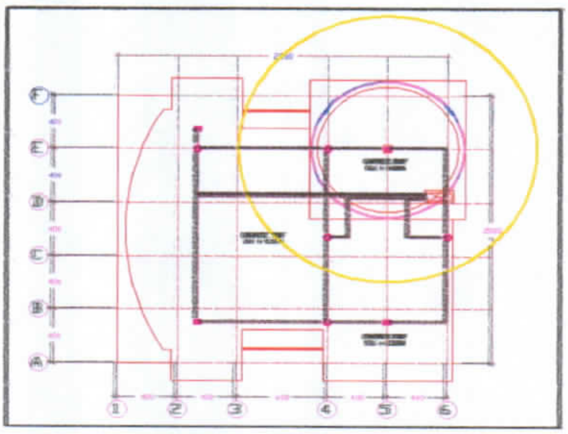


Figure 3. Air Termination length 40 cm (Top View)

Based on the method of corner protection, which is visible from the building rector that the placement of the termination of the air in the highest *part of the building with the termination-conditioned* building PTIPD not be protected as a whole, the placement of termination is appropriate which is located at the highest position of the building, but because the building has only one termination with only 40 cm long, so it does not provide protection for the entire building. Need for additional air *termination and also increase in length at each* termination air. Based on SNI 03-7015-2004 air termination in SPP that is used should have a length of 2 m to 3 m, also rearranged termination laying of air so that the entire building PTIPD protected optimally.

Results of the External Protection System Design

Corner Protected method

The design of this study was first done with Angle Protected method, this method makes an angle of protection in accordance with the upright conductor, where the protected areas are areas that are within the cone with angle protection in accordance with the level of protection. In the application of hedge angle method, based on data from Table 4.1 it can be seen that the building PTIPD UIN Suska Riau have protection level IV, so based on Table 3 can be obtained according to the method of protection of the space protected corner building heights of 20 meters is equal to 550.

From the evaluation performed on the external lightning protection system exists, UIN Suska Riau PTIPD buildings not protected optimally, so that the need for increasing the number of terminations into 3 pieces with a length of 3m, is expected to protect the whole building PTIPD UIN Suska Riau.

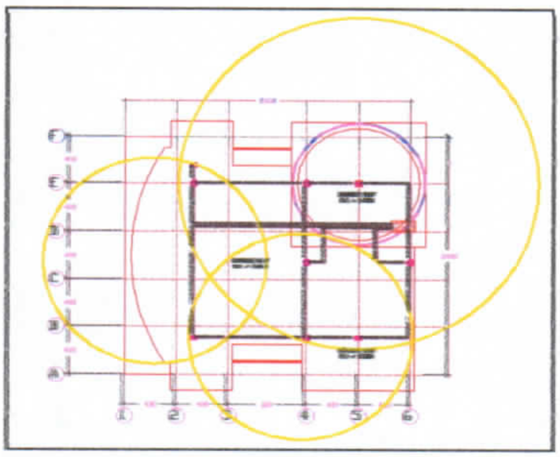


Figure 4. Building with 3 Termination Air PTIPD length 3m (Top View)

Corner Protected method obtained with the draft placement of air terminations that practically protects the entire building, there are still parts of the left side of the front and rear and right front side of the building that have not been fully protected.

Rolling Ball Method

Good rolling ball method used in the building that looks complicated. With this method as if there is a sphere with radius R rolling on the ground, around the structure and on top of the structure in all directions to meet with the land or structures related to the earth's surface that is able to work as a conductor. Point touch the ball rolling on the structure is a point that can be struck by lightning, and at that point must be protected by the air termination conductor. The design with this method can be seen on the following image

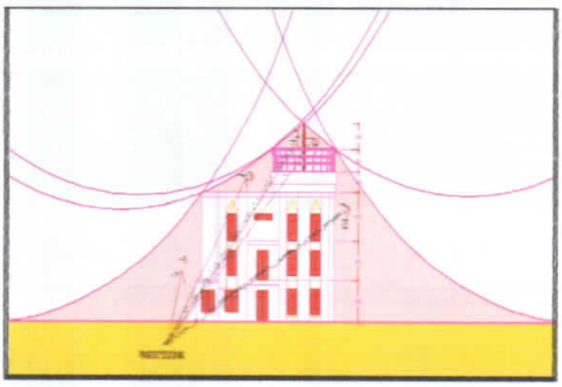


Figure 5. Building PTIPD Protection Method Using Rolling Ball (Front)

Based on the results of observations made, then using a rolling ball 4 termination are to be installed in the building PTIPD UIN Suska. By planning the installation of 4 pieces finial on the roof of the building PTIPD UIN Suska Riau have been enough to protect the entire building from lightning strikes. For fixing air termination is at the highest point of the building and at the ends of the building.

Methods Jala

This method is used for the protection of a flat surface because it can protect the entire surface of the building. Protected area is the entire area that is in the nets. If this method is applied to buildings PTIPD UIN Suska Riau Pekanbaru, the obtained minimum net width appropriate, placement of air terminations in accordance with protection level IV reaches 20 meters. With the placement of air terminations at the ends of the roof of the building. The dotted lines depicted is a conductor on the roof and down conductors.

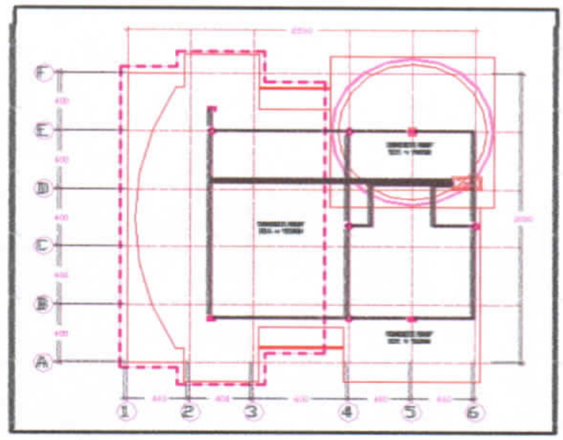


Figure 6. Protection PTIPD Building Method Using Jala (Top View)

When analyzed using the mesh method for the placement of air terminations on the ends of the roof of the building Puskom the highest part of the building is not protected. This leads to a high risk of lightning strikes directly. This method is considered unsuitable if applied to buildings Puskom UIN Suska Riau. Due to the shape of the roof of the building that are not flat. However, when given a termination air on top of antenna contained in the building so the building can be optimally protected against direct lightning strikes.

Building Grounding System PTIPD

Measurement of earth in building PTIPD prisoners had been done, the measurement is done by way of implanted electrodes kinds of copper rod with a diameter of 1.5 cm into the soil to a depth of 1 m, grounding resistance value obtained at 179 ohms, grounding prisoners measurement can be seen in the picture below

Figure 7. Grounding Resistivity Measurements in Building PTIPD UIN Suska Riau

Table 8. Calculation of Soil Resistivity type PTIPD Building UIN Suska Riau

number of Electrodes	Type	Diameter (cm)	Grounding Resistivity (ohm)	Prisoners Soil type (ohm meter)
1	Copper	1.5	179	212.94

The calculation result obtained soil resistivity 212.94 ohm meter, based on Table 2.13, the type of soil found on wet gravel categorized PTIPD building.

Prisoners grounding sedapatnya highest-value 5 ohms, based on calculations by the electrode single rod obtained depth electrodes should be planted along 72 m, but in practice the planting of the electrodes do not allow reaching a depth that is supposed to be, more research is proposed to reduce the value of resistance grounding include planting rod electrodes in parallel, adding zat reducing and so forth.

Conclusions and Recommendations

Conclusion

1. Needs lightning protection systems for buildings PTIPD UIN Suska Riau based on the level of protection at the level of IV with forecasts of a great danger to the placement of the termination of the air for the method of nets minimum distance between an antidote to her is as big as 20 meters, diameter of the method of ball rolling is 60 meters, while the protection angle method with 20-meter high protective angle is equal to 550.
2. The results of the evaluation of external protection system building UIN Suska Riau PTIPD currently not able to protect the building with optimal from a lightning strike.
3. External protection system design is done by three methods: Corner Protected method, the method Eye nets, and Rolling Ball method that has given the region a better protection of the external protection system that already existed.
4. External SPP protection PTIPD building with optimal UIN Suska Riau has been obtained, the results of the three draft note that bergulirlah ball method that provides optimal protection results in buildings with protected areas covering the whole area of the building.

Suggestion

1. Need for assessment or evaluation of internal lightning protection system of the building PTIPD UIN Suska Riau.
2. Need to assess the external lightning protection system with the Base Transceiver Station (BTS) located next to the building PTIPD UIN Suska Riau.

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